

Code Blue: Endangered Oceans



Introduction:

As human population has increased and land uses have changed, our oceans have been negatively altered. This demonstration illustrates that, just as we each contribute to the problem, we must also be a part of the solution.

Materials:

1 clear rectangular plastic container of water (or a large clear bowl)

Salt

10 opaque canisters (ex: film canisters)

Canister labels

Character cards

Extraction cards

Masking tape

Canister ingredients (listed below) - all ingredients are safe for students to handle

14 clothespins

*Note: This lesson plan is written for 17 students. If you have more than 17 students, you may double up on some of the characters.

Canister Ingredients:

Dry Ingredients:

| Character | Ingredient |
|-------------------|---|
| Algal blooms | Green yarn |
| Abandoned nets | Fishing line, hair net or floss |
| Antibiotics | Baking soda |
| Litter | Cut-up plastic bag |
| Natural disasters | Broken up toothpicks, scrap pieces of paper |

Wet Ingredients:

| Character | Ingredient |
|----------------------|--|
| Chemical fertilizers | Vinegar and green food coloring |
| Coal | Water and red food coloring |
| Off-shore oil wells | Cooking oil with 2 drops red and 2 drops green food coloring |
| Ocean acidification | Vinegar |
| Sewage | Water and instant coffee grounds |

Concept:

Humans' impacts on the ocean provide insight into the effect that a population of seven billion has on natural resources and the difficulties of managing an international commodity.

Objectives:

Students will be able to:

- List the principal pollutants in our world's oceans.
- Understand how humans are altering ocean ecosystems.
- Draw connections between individual actions and results at the global level.
- Develop strategies for minimizing and counteracting international environmental problems.

Subjects:

Civics, Economics, Family and Consumer Sciences, Geography, Health, History, Language Arts, Science, Social Studies

Skills:

Critical thinking, listening and observing, role playing, understanding cause and effect

Method:

Through an interactive story, students experience the pollution of the oceans over time and critically examine ways to protect and manage our oceans worldwide.



Other ingredient:

| Character | Ingredient |
|----------------|--|
| Sea level rise | Fill a large measuring cup or drinking cup with water and tape the “Sea level rise” canister label to the side of the cup. Give this cup to one student instead of a smaller canister. |

Extraction Characters:

| | |
|----------------------|--------------|
| Whaling | Marine Birds |
| Fishing Technologies | Aquaculture |
| Bycatch | Coral Reefs |

Procedure:

Before Class:

1. Fill a large container with water until it is approximately half full.
2. Print the canister labels from the props section of this activity. Prepare the canisters by taping one canister label to each and filling it with the appropriate material from the list above.
3. Print out each of the six extraction cards, laminate them if desired, and tape or velcro one of each to the side of the bowl. Each extraction card represents a type of organism currently found in the ocean.
4. Print out the six character cards and laminate them if desired.

**Note: Each extraction card has a matching character card. The extraction card is attached to the bowl while the character card is given to the students.*

During Class:

5. Pass out the canisters and character cards so each student has one.
6. Explain that you will be reading a story about the history and health of our oceans. Instruct the students to listen for the name of the character printed on their canister or character card. When they hear the name in the story, they should pour the contents of their canister into the bowl. If they have a character card instead of a canister, they should find the matching extraction card from the side of the bowl and remove it. After removing their organism, they should hold it up for the class to see and say what they have removed.
7. Tell the students that the clothespins or binder clips depict the world population. Each one illustrates 500 million people, and you should begin the demonstration with one clip on the side of the bowl and end with 14. You may decide to have a few students be the “population monitors” and add clips throughout the story so that you do not have to pause.
8. Read the story, adding emphasis and pausing on the bolded words so that students will remember to add their pollutant or remove their character.
9. Go over the discussion questions as a class or in small groups.



Props:

Canister Labels (print and tape to the side of the canisters)

**Algal
Blooms**

**Natural
Disasters**

**Abandoned
Nets**

**Off-Shore
Oil Wells**

Litter

Antibiotics

Sewage

**Chemical
Fertilizers**

Coal

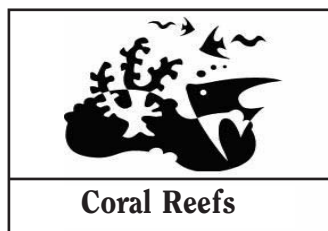
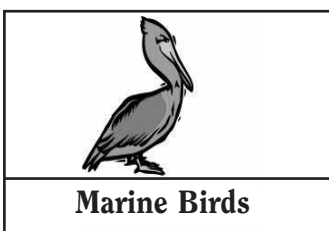
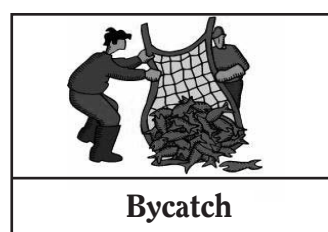
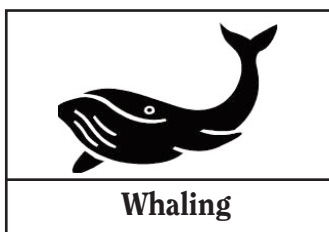
**Sea Level
Rise**

**Ocean
Acidification**

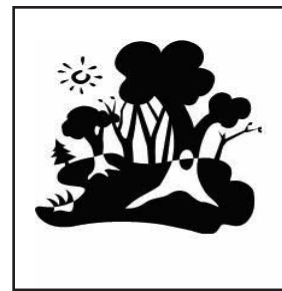
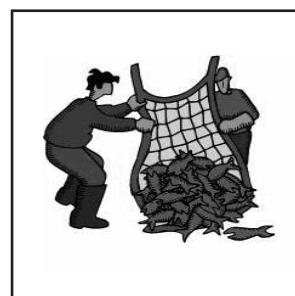
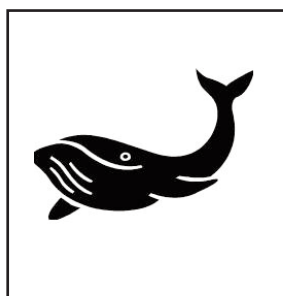


Props (cont.):

Character Cards (Print and give one to six students in the class in place of a canister)



Extraction Cards (print and tape to the side of the large bowl)





Story:

Throughout humans' existence on earth, we have made our home on the coasts of the ocean, depending on its resources for food and transportation. The ocean makes up over 70% of the earth's surface, is teeming with wildlife, and is responsible for much of our climate patterns. Imagine that this container of water represents the ocean 500 years ago (*pour salt into the container*). Back then, our world population was 500 million, or about 1/14 of what it is now (*place one clothespin on the side of the container*). The oceans were filled with diverse ecosystems of corals, invertebrates, fish and mammals, all relying on each other in interconnected food webs.

However, the ocean has changed a lot since 1500 and this is a story of those changes.

One hundred years passed by and starting in the 1600s, people began to recognize the ocean's wealth as harvestable. **Whaling** began in Northern Europe where men would use large harpoons to kill whales and convert their blubber into a source of oil. Over the course of 200 years, whaling became a prominent industry and decimated whale populations throughout the north. Currently, there is an international moratorium on commercial whaling; however, some countries such as Japan, Norway and Iceland continue the practice.

In the early 1800s, world population had reached one billion (*place another clothespin on the bowl*) and scientists and farmers were looking for ways to increase crop yields to feed the population. Scientists began creating **chemical fertilizers** with high levels of nitrogen, phosphorous, and potassium. Nitrogen is highly soluble and when used in large amounts, can run off into large bodies of water. Increases in nutrients in the ocean cause **algal blooms** that consume all of the oxygen in an area and create a dead zone where no other organism can live. The small amounts of chemical fertilizers used at that time weren't enough to cause these troubles and people in the 1800s never thought that the human population would grow enough to overuse fertilizers to the extent that they would become a problem.



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The Industrial Revolution in the mid-19th century ushered in a new era of technologies and jump-started a fossil-fuel based economy. **Coal** was the new main energy supply, but it caused a large amount of air pollution. Burning coal was also a source of mercury poisoning in our ocean system. Trace amounts of mercury found in coal were released as coal was burned, and it moved into our atmosphere and our oceans. Fish ingest the mercury and humans are susceptible to illness if they eat fish with high mercury content.

- *What has changed about the oceans from 1500 to 1850?*
- *How have humans been helped/hurt by these changes? Possible answers: Helped—more access to food due to fertilizer use and whaling; better transportation systems to get us across. Hurt—less biodiversity because of the algal blooms and whaling; water has high levels of mercury.*

In the early 1900s, the first **off-shore oil wells** were dug off the coast of California to try to keep up with growing demand for oil. The first major oil spill was in California in 1910 and dumped 378 million gallons of oil into the Pacific, devastating the ecosystem. By 1930, when world population reached two billion (place 2 more clothespins on the bowl), oil companies began constructing oil



platforms in the Gulf of Mexico. Today, there are approximately 300 off-shore rigs, with nearly a third of them located in the Gulf of Mexico. The most recent spill occurred on April 20, 2010 due to an oil rig explosion. It took nearly three months to stop the flow of oil into the Gulf of Mexico, which had devastating effects on the environment, but also for the Gulf Coast community and economy.

In the 1950s, much of the maritime technology that was developed during World War II was converted into new **fishing technologies** to help feed the three billion people on the planet (*place 2 more clothespins on the bowl*). However, these technologies caused severe overfishing, as fishermen could now catch thousands of pounds of fish in one outing. These new technologies, including trawling, scraping the seafloor with large nets, would catch anything and everything. Additionally **bycatch**, or the accidental catch of marine life, was becoming a problem as turtles, dolphins, and other fish were often caught and killed in fishing gear that was meant for other animals. **Abandoned nets**, fishing lines, and traps can also continue to kill animals for weeks after they have been deployed if fishermen forget to retrieve them. Currently, 70% of fish stocks are fished at or over capacity, with extreme harm being done to large predator fish. The cod fishery in the Northeastern United States and Canada had record high catches in the 1960s, but later collapsed due to overfishing.

Even with the fishing boom, we weren't producing enough fish to provide for our growing population. In the 1970s when world population reached four billion, (*place 2 more clothespins on the bowl*) **aquaculture**, or raising fish in pens as you would cows or chickens, became a growing industry, especially in Asian countries such as Indonesia and Thailand. In many rural areas, coastal ecosystems were decimated as fish farmers cleared mangrove forests to create more aquaculture. These mangroves were home to hundreds of species of birds and fish, but were converted into large feeding pens of shrimp and salmon. Due to the density in which the fish are grown, they must put large quantities of **antibi-**



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otics in the water to keep the animals healthy. Unfortunately, these antibiotics seep into the oceans and pollute our water, endangering our public health as well as our food sources.

By 1987, world population was at five billion people (*place 2 more clothespins on the bowl*) who were together producing millions of pounds of trash. This **litter** from land sources, commercial ships and cruise vessels entered the ocean system as pollution. By 1997, with population nearing six billion (*place 2 more clothespins on the side of the bowl*), scientists discovered two "Plastic Islands" in the Pacific and Atlantic Oceans. These massive mounds of plastic, created by water currents, seep chemicals into the water, and kill **marine birds** who consume the plastic.

Litter isn't the only pollution we have to worry about. In many countries, sewage treatment facilities are not available, and **sewage** from cities and households runs directly into our rivers and oceans. This isn't only in developing countries. Even Venice, Italy is just beginning to implement a sewage treatment plan.

Recognizing the global nature of the problems our oceans were facing, international bodies have been created to monitor pollution, climate, and fishing industries. However, it was and still is difficult to get countries to agree on an action plan, and, without an enforcing body, many countries still do not comply with the agreements. As we move forward to a population of 7 billion people in 2011



(place 2 more clothespins on the side of the bowl) all of the detrimental effects of our abuse of the ocean are accumulating. Increased concentrations of carbon dioxide, or CO₂, in the air from burning oil and coal have led to Arctic ice melting and **sea level rise**. Low lying countries such as Bangladesh, Papua New Guinea, and islands in the Pacific Northwest have already had to evacuate some communities due to permanent sea-level rise. Similarly, increases in CO₂ alter the ocean's chemistry and lower the pH of the water, causing **ocean acidification**. Many organisms can only handle a narrow range of pH in their environment and this acidification has caused the death of **coral reefs** and the rich biodiversity that relies on coral. Both coral reefs and the mangrove forests normally act as natural buffer zones against storms for coastal communities. With increases in global temperatures, storms are increasing in intensity, and without these natural protective structures, **natural disasters** wipe out entire towns and wash them into the water. Mangrove forests are also a "carbon sink," sequestering or soaking up carbon dioxide from our atmosphere. Without them, the cycle of global warming and ocean acidification continues.

Discussion Questions:

1. Who polluted the ocean?

Everyone played a part. Students should mention that each country had an impact, but every one shares the oceans.

2. What effect did increasing population have on the health of the ocean? Can you think of any ways that population increase helped the oceans?

In this situation, population growth led to increases in pollution sources and decreases in open space and in available wetlands, which filter water. However, the increase in population also led to stronger environmental laws, more efficient uses of resources and public services like sewage treatment plants.

3. Think about the pollution held in the canisters. Could something be done to prevent those types of materials from entering the water? How?

Possible answers include: use less chemical fertilizers; be selective with what types of products we purchase and eat; recycle; participate in beach clean-up projects; use alternative transportation; etc.

4. Think about the organisms that were removed or destroyed due to human activities. They aren't confined to just one area of the world, but swim freely around the globe. Who owns these animals? Who should manage how many of these creatures people are allowed to remove? How can these management systems be enforced internationally?

These questions are all discussion questions with many answers. Guide students to understand that there are international management systems that sign treaties to protect international interests (ICCAT, IPCC, IWC) but that these treaties are difficult to enforce.

5. Were all of the inputs human caused? Which ones were? Which ones weren't?

Many were human caused, but natural disasters like tsunamis and mudslides can't be prevented. However, human activities can affect how devastating these natural disasters are by destroying



natural buffers to storms, like mangrove forests, coral reefs, or cutting down trees that are meant to stop erosion and nutrient depletion. We also increase the intensity of these storms through global warming.

6. Think about the impacts of sea level rise in coastal communities. Where will these impacts be the worst?

Areas with high population density living in very low-lying areas. The poorer, tropical regions will be the most impacted.

7. Do you think that it is easier to prevent pollution by managing ocean resources beforehand, or to clean it up and restore it later?

To prevent it in the first place.

8. What could each of us do to help improve the health of our oceans?

Possible answers include: using alternative transportation besides just cars, conserving water, eating organic foods or foods produced with natural fertilizers, only eating sustainably harvested seafood, etc.

Follow-up activities:

1. Have students research the piece of the story that seemed the most interesting or relevant to them. For example, they could research overfishing, ocean acidification, whaling, the Plastic Islands, or sea level rise and climate change. Then, have them write a short essay with more specific details and examples of how their research topic impacts the oceans. Students can also research impacts that were not included in this story.
2. Have a discussion about international policymaking. What are the difficulties of getting countries to solve problems together? What is the best method of solving these problems? Have students research an international policy or regulatory body of their choice (Montreal Protocol, Kyoto Protocol, International Panel on Climate Change, International Whaling Commission, or the Convention in the Trade of Endangered Species). Ask them to write a short paper on the history of the policy, which countries were major players in the debate, and why it was important or controversial. Alternatively, they could work in groups and give a short presentation to the rest of the class on their treaty or commission.

Potential sources for further reading:

- Monterey Bay Aquarium Seafood Watch Program, <http://www.montereybayaquarium.org/cr/seafoodwatch.aspx>
- National Oceanic and Atmospheric Administration, <http://www.noaa.gov/ocean.html>
- Pew Environment Group—specializes in oceans and global warming, http://www.pewtrusts.org/our_work_category.aspx?id=110
- Ocean Conservancy, <http://www.oceanconservancy.org/>
- U.S. Commission on Ocean Policy “An Ocean Blueprint for the 21st Century”, <http://oceancommission.gov/>

Information on various International Organizations that are working on these issues:

- Intergovernmental Panel on Climate Change: <http://www.ipcc.ch/>
- International Whaling Commission: <http://iwcoffice.org/>
- International Commission for the Conservation of Atlantic Tunas: <http://www.iccat.int/en/>
- International Coral Reef Initiative: <http://www.icriforum.org/>